

Physics

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(Chapter 1) (Electric Charges and Fields)
(Class 12)

Question 1.1:

What is the force between two small charged spheres having charges of 2×10^{-7} C and 3×10^{-7} C placed 30 cm apart in air?

Answer 1.1:

Repulsive force of magnitude 6×10^{-3} N

Charge on the first sphere, $q_1 = 2 \times 10^{-7}$ C

Charge on the second sphere, $q_2 = 3 \times 10^{-7}$ C

Distance between the spheres, $r = 30$ cm = 0.3 m

Electrostatic force between the spheres is given by the relation $F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2}$

Where, ϵ_0 = Permittivity of free space and $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ Nm 2 C $^{-2}$

Therefore, force $F = \frac{9 \times 10^9 \times 2 \times 10^{-7}}{(0.3)^2} = 6 \times 10^{-3}$ N

Hence, force between the two small charged spheres is 6×10^{-3} N. The charges are of same nature. Hence, force between them will be repulsive.

Question 1.2:

The electrostatic force on a small sphere of charge $0.4 \mu\text{C}$ due to another small sphere of charge $-0.8 \mu\text{C}$ in air is 0.2 N.

(a) What is the distance between the two spheres?

(b) What is the force on the second sphere due to the first?

Answer 1.2:

(a) Electrostatic force on the first sphere, $F = 0.2$ N

Charge on this sphere, $q_1 = 0.4 \mu\text{C} = 0.4 \times 10^{-6}$ C

Charge on the second sphere, $q_2 = -0.8 \mu\text{C} = -0.8 \times 10^{-6}$ C

Electrostatic force between the spheres is given by

$$F = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{r^2}$$

Where, ϵ_0 = Permittivity of free space and $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ Nm 2 C $^{-2}$

Therefore,

$$r^2 = \frac{1}{4\pi\epsilon_0} \cdot \frac{q_1 q_2}{F} = \frac{0.4 \times 10^{-6} \times 8 \times 10^{-6} \times 9 \times 10^9}{0.2} = 144 \times 10^{-4}$$

$$\Rightarrow r = \sqrt{144 \times 10^{-4}}$$

$$= 12 \times 10^{-2}$$

$$= 0.12 \text{ m}$$

The distance between the two spheres is 0.12 m.

(b) Both the spheres attract each other with the same force. Therefore, the force on the second sphere due to the first is 0.2 N.

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